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METHOD FOR STERILIZING PET BOTTLES

> BACKGROUND OF THE INVENTION

The invention relates to a method in which a sterilizing agent is used to sterilize bottles of a temperature-sensitive plastic, especially PET bottles, which are being advanced along a conveying path periodically.

> SUMMARY OF THE INVENTION

It is known that bottles of a temperature-insensitive material, such as glass, can be sterilized by introducing peroxide into the interior of the bottles at a temperature, at which the peroxide splits off oxygen immediately after it is introduced into the bottle, the oxygen bringing about the sterilizing action. In the case of bottles of a temperature-sensitive material such as PET, it is not possible to carry out such a sterilization method, because the walls of the bottles reach a temperature above a still permissible limiting temperature of, for example, 55°C.

The invention is concerned with the problem of providing a method of the type mentioned above, which permits even temperature-sensitive bottles to be sterilized with the help of peroxide as sterilizing agent and, at the same time, can be carried out easily and rapidly within a short, conveying distance.

The inventive method is accomplished by the distinguishing features of claim 1. For further developments, reference is made to claims 2 to 15.

The inventive method enables bottles to be sterilized with the help of a peroxide fog, which is blown into the bottles for briefly forming a condensate on the inner surface of the bottles, the peroxide, as a result of being heated to a temperature, at which sterilization commences, already being at a stage, at which a certain portion of it is converted into the gaseous form already upon being introduced into the bottles. By blowing in sterile air at a temperature, at which the peroxide is activated, the latter is activated while, at the same time, the condensate film is removed by the oxygen splitting off, the sterilization is brought about and, subsequently, the peroxide, together with the remaining components, is blown out of the interior of the bottles. During these processes, the temperature of the walls does not exceed a value of 55°C, so that the sensitive material of the bottles, such as PET bottles, is not affected.

Fig. 1 Further details and effects of the object of the invention arise out of the following description of the course of, the method by means of a sketch, which illustrates the periodic passage of groups of bottles through a sterilization station of the inventive type.

IN THE DRAWINGS
In particular, the drawing diagrammatically shows a sterile chamber 1, which forms a spraying-in space 2, a first sterile space 3 and a sterile space 4, through which in each case groups of, for example, bottles 8 pass aligned consecutively in the plane of the drawing. At the same time, the bottles 8 are supported in bottle carriers 5, which have a beam shape and are conveyed by means of a conveyor 6, which is indicated only diagrammatically by a line of dots and dashes, horizontally in the direction of the arrow

7. The conveying takes place in time, the groups of bottles in each case passing through stationary positions labeled 10 to 19. It is self-evident that there may be further positions before position 10 and further positions after position 19, in which the bottles are acted upon, for example, by preceding rinsing drying processes and subsequent filling and sealing processes.

In position 11, heated peroxide aerosol is blown with the help of a lance 20 into the bottles 8 of temperature-sensitive plastic, especially PET bottles. Together with its supplying line 21, the lance 20 can be moved in the direction of arrow 9 out of an upper starting position into the lower operating position, which is not shown, with the help of a driving mechanism, the details of which are not shown. The supplying line 21 leads to a peroxide aerosol generator, which is not shown and, which generates peroxide aerosol under pressure and, when the lance 20 is lowered, blows the peroxide or H_2O_2 fog into the interior of the bottles 8. The peroxide oxide fog, introduced into the bottles 8 over the lances 20, has a sterilization starting temperature of about 60° to $90^\circ C$ and preferably of about 70° to $80^\circ C$, at which a certain portion of the H_2O_2 already changes over into the gaseous form, oxygen being split off. Nevertheless, the temperature is so low that, even if the same process is repeated in position 12, the walls of the bottles 8 do not experience any heating, which comes close to a dangerous limiting temperature of, for example, $55^\circ C$, during the formation of a condensate film on the inside of the bottles 8.

After this two-step introduction of peroxide aerosol into the bottles 8, the latter pass from the spraying-in space 2 of the sterile chamber 1 into the first sterile chamber 3, which, like the sterile chamber 4, is constructed lower. The bottles 8, into the inside of which aerosol has been sprayed, remain in the two positions 13 and 14 in the first sterile space 3 without being acted upon further from the outside. After that, they are transferred into position 15, where they are acted upon with sterile air through a lance 22 which, together with its supplying line 23, can be lowered in the direction of arrow 9 also from an upper starting position into the operating position shown and vice versa.

This sterile air, blown in in positions 15 and 16, has an activation temperature of about 90° to 120°C and preferably of about 110°C and causes the condensate film on the inner surface of the bottles to be evaporated. This process of evaporating the aerosol condensate film is divided into two steps in positions 15 and 16 and terminated only in position 16, in which the same process of blowing in sterile air, heated to the activation temperature, is repeated. The sterile air, heated to the activation temperature, is blown in only briefly during a period of about 1 to 3 seconds and preferably of 2 seconds, at a flow rate of about 25 to 30 m/s and preferably of about 28 m/s. In spite of the heat content of the sterile air, heated to the activation temperature, the wall of the bottles 8, even in positions 15 and 16, remains within a temperature range below the limiting temperature of about 55°C .

In order to drive out residues of peroxide from the interior of the bottles 8 and to dry the inner wall of the bottles reliably, sterile air is blown in once again in positions 17 and 18, however at a lower temperature, in order to avoid also into these two positions that the limiting temperature of the walls of the bottle is reached. This reduced temperature of the sterile air in positions 17 and 18 is about 75° to 85°C and preferably about 80°C and is blown in with a flow rate of about and 70 to 90 m/s and preferably of about 80 m/s into the interior of the bottles and, moreover, also once again for a period of only about 1 to 3 seconds and preferably also of about 2 seconds. The sterile air of reduced temperature admittedly brings about an effective expulsion of peroxide residues and a reliable drying of the interior of the bottles 8. However, it also avoids a transfer of heat to the bottles 8 to an extent, which could bring about heating of the walls of the bottles above the limiting temperature. As in positions 11 and 12 or 15 and 16, the sterile air is blown in with the help of a lance 24, which is connected with a supplying line 25 and, together with the latter, can be moved in the direction of the arrow 9 from an upper starting position downwards into the lower operating position shown and vice versa. The lances 20 in the positions 11 and 12, 22, in the positions 15 and 16 and 24 and in the positions 17 and 18 can be moved up and down in each case by means of one and the same driving mechanism.

When the blowing of sterile air into the bottles 8 in position 18 is stopped, the sterilization process is concluded. After leaving position 18 and the sterile space 4, the

bottles go over into position 10 and the following positions into, for example, a further sterile space, in which the bottles are filled and the filled bottles are sealed.

The amount of aerosol used, which preferably is fogged at ambient temperature and heated to the starting temperature for the sterilization only on the way to the lances 21, depends on the size of the bottles and preferably is about 0.15 ml of peroxide per 100 cm² of inner space surface of the bottles 8.

In principle, it is possible to blow in peroxide aerosol in a single step, for example, in position 11, and to shorten the processing pause to one step, such as in position 13. The blowing-in processes can also take place, in each case, in a single step, for example, in positions 15 and 17. However, with regard to the course of the transfer of heat to the walls of the bottles, it is more advantageous to divide the blowing-in processes among several steps, in order to avoid an increase in temperature to the limiting temperature. In principle, instead of two steps, more than two steps can also be provided for blowing in peroxide aerosol and for the processing pause and for blowing in sterile air. However, this is associated with a prolongation of the sterilization time and distance, which causes correspondingly higher costs.

The wall regions of the sterile chamber 1 underneath and to the side of the group of bottles 8 are not shown but are present. Appropriate locks at the transition of the groups of bottles from position 10 into position 11 and from position 18 into position in 19 are also present, but not shown.